Chemical and biological tests to assess the viability of amendments and *Phalaris arundinacea* for the remediation and restoration of historic mine sites

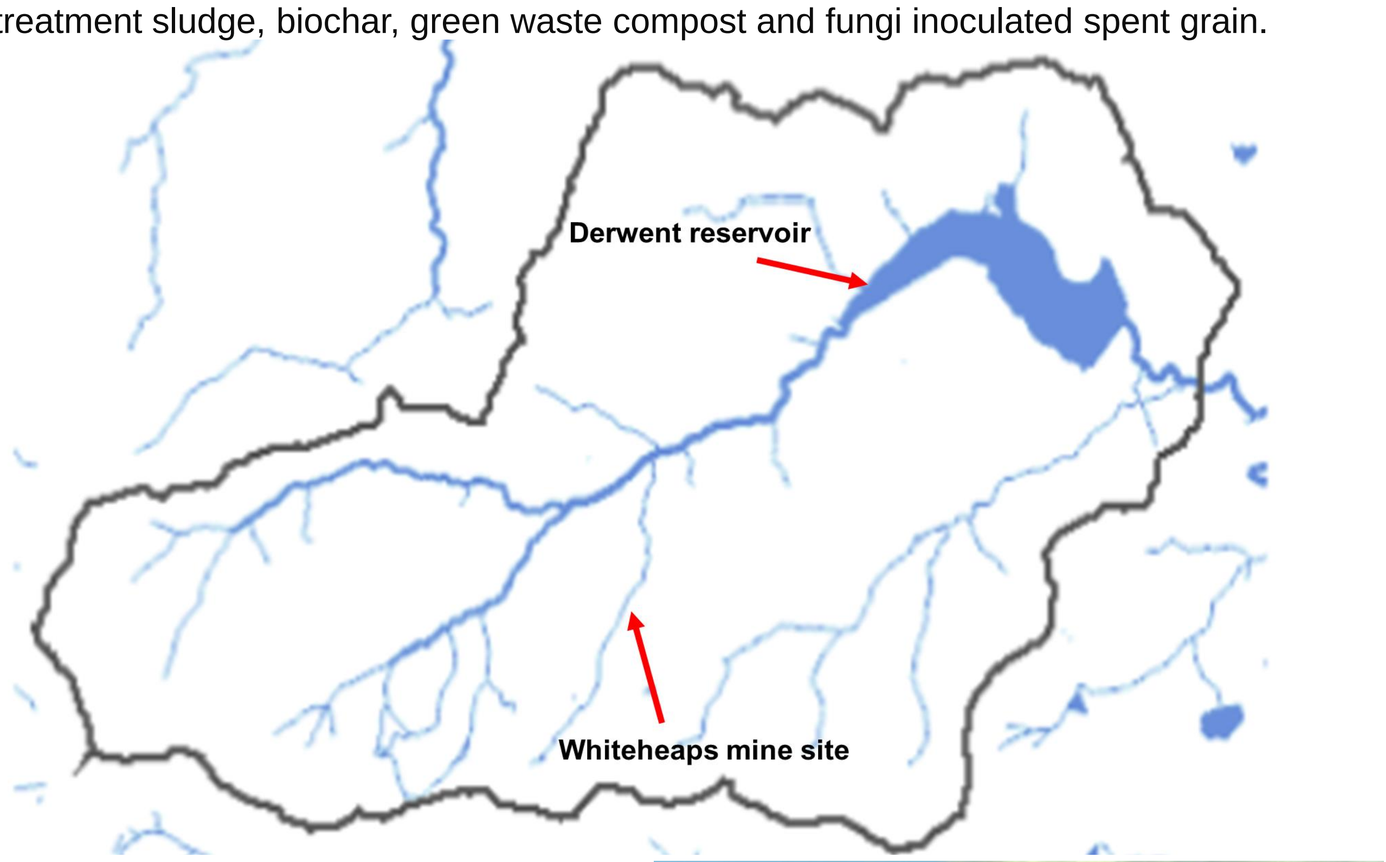
Benjamin Nunn[1], Richard A Lord[1] and Christine M Davidson[2]

[1]Department of Civil and Environmental Engineering, University of Strathclyde, 75 Montrose Street, Glasgow G1 1XJ (benjamin.nunn@strath.ac.uk),

[2] WestCHEM Department of Pure and Applied Chemistry, University of Strathclyde 295 Cathedral Street, Glasgow G1 1XL

Summary

- This study aims to trial the use of plants and amendments capable of potentially toxic element (PTE) immobilisation to reduce the dispersion of metals at a former lead-zinc-fluorspar-baryte mining area of the Northern Pennine Orefield within the catchment of Derwent Reservoir. A previous scoping study by Strathclyde University highlighted the contribution of mineral processing areas as sources of particulate and dissolved PTEs entering the Upper Derwent river system.
- The native perennial grass species Reed Canary Grass (RCG) (*Phalaris arundinacea)* has been selected for its ability to colonize and stabilize contaminated soils whilst not typically accumulating high levels of PTEs from the soil and thus creating a further mobilisation mechanism. The low planting cost, rapid growth and dense rooting habit of RCG make it a useful species for phytostabilisation although breeding objectives have not yet focused on cultivating these traits [2].
- The immobilization of PTEs can be achieved through the use of low leaching organic waste amendments capable of adsorption, precipitation and complexation reactions [1-2]. The amendments used here are locally procured; water treatment sludge, biochar, green waste compost and fungi inoculated spent grain.



Determined	Unit	MINE SOIL 1 (WH3)	MINE SOIL 2 (WH5)
pH	Value	6.7	7.1
Copper	mg/kg	545	890
Zinc	mg/kg	1852	5150
Lead	mg/kg	13873	9112
Arsenic	mg/kg	40.7	66.2
Cadmium	mg/kg	5.07	6.3
Nitrate Nitrogen	mg/kg	<1	<1
Ammonium Nitrogen	mg/kg	<1	<1
Available Phosphorus	mg/l	<2.5	<2.5
Available Potassium	mg/l	30	34

Experimental Design

Pot trials using bulk samples taken from the two selected sites and amendments have followed an adapted British Standards (BS/EN 11269-2:2013) method for the effects of PTEs on above ground plant growth. A combination of biological and chemical approaches will be used to analyse the efficacy of the plants and different amendments throughout this study. These will include the use of the modified BCR sequential extraction procedure [3] and single extractants (EDTA and $CaCl_2$) to assess PTE bioavailability, the monitoring of changes in soil properties (OM, pH and CEC) and the measurement of above/below ground biomass after 12 weeks of growth.

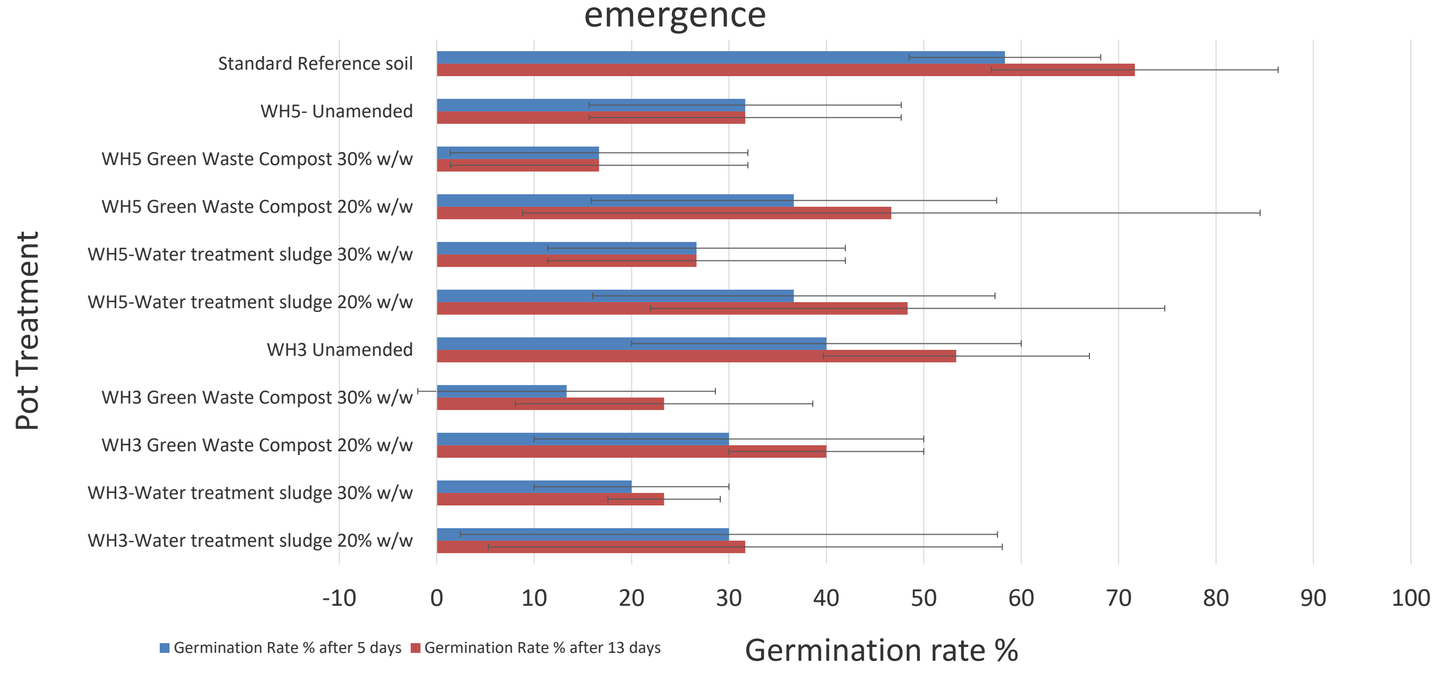
Water treatment sludge 20%

Green waste compost 20%

Unamended

John Innes Compost (Control)

Pot trials - week 10 - WH3



Future Work

The results of the pot experiments will inform a two year on site field trial beginning in Spring 2019. Although several recent studies have conducted similar pot trials, very few have applied their results to a field trial, a recommendation commonly made in key literature reviews [1].

Acknowledgements

The author would like to thank Northumbrian Water Ltd and the University of Strathclyde Civil and Environmental Engineering Faculty and Department for supporting this project.

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Contact

Email:benjamin.nunn@strath.ac.uk

Twitter: @BenjaminNunn1

Linkdin:BenjaminNunn